B.R. 33003/262
February, 1969

BRITISH RAILWAYS

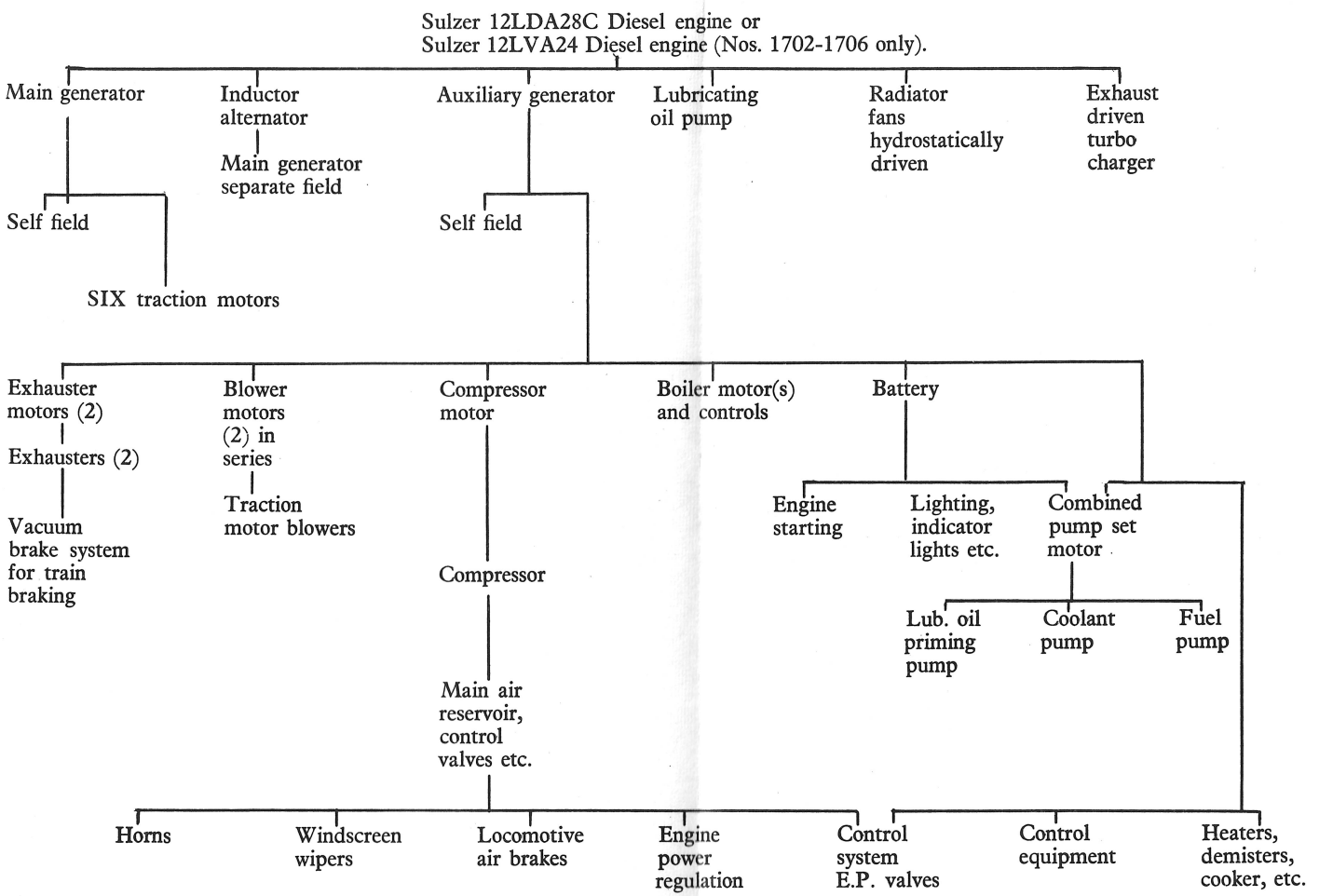
BRUSH SULZER 2600 H.P. CLASS 47 AND 2650 H.P. CLASS 48 DIESEL ELECTRIC LOCOMOTIVES FITTED WITH VACUUM-AIR BRAKES

PART 1

GENERAL DATA AND EQUIPMENT FITTED

POWER AND TRANSMISSION SYSTEM

The power of the Diesel engine is utilised as follows: -



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LOCOMOTIVE DATA

At the time of writing these instructions the Sulzer/Brush Class 47 locomotives, which were originally built with vacuum/air brakes, are being converted to automatic air brake operation. The data given below is in respect of vacuum air brake locomotives only, but due to the conversions which are taking place a list of applicable numbers cannot be given.

Type	C-C.
Weight in running order	114 tons approx.
Tractive effort:-	
Maximum	62,000 lbs. up to 10.5 m.p.h.
Continuous	30,000 lbs. at 26 m.p.h.
Wheel base	51ft. 6in.
Bogie wheel base	14ft. 6in.
Wheel diameter	3ft. 9in.
Bogie centres	37ft. 0in.
Width overall	8ft. 9¾in.
Length overall	63ft. 6in.
Height overall	12ft. 9⅜in.
Minimum curve negotiable	4 chains radius.
MAXIMUM PERMITTED SPEED	95 m.p.h.
Main Fuel Tank capacity including the boiler supply	850 gallons.
Boiler water tank capacity (on locomotives fitted)	1,250 gallons.

POWER EQUIPMENT, DIESEL, CLASS 47 LOCOMOTIVES

12 Cylinder diesel engine	Sulzer type 12LDA28C, double bank, in line, pressure charged, intercooled, four-stroke.
Rating	2,600 H.P. at 750 r.p.m.
Idling speed	325/365 r.p.m.

POWER EQUIPMENT, DIESEL CLASS 48 LOCOMOTIVES

12 Cylinder diesel engine	Sulzer type 12LVA24, "V" engine, pressure charged, intercooled, four-stroke.
Rating	2,650 H.P. at 1,050 r.p.m.
Idling speed	450 r.p.m.

POWER EQUIPMENT, ELECTRICAL, CLASS 47 AND CLASS 48 LOCOMOTIVES

Main generator	Brush. Continuous current rating at maximum engine speed, 2,130 amps. series-parallel or 4,260 amps. parallel traction motors.
Traction motors	Brush. 6 in series-parallel or parallel connections.

AUXILIARY EQUIPMENT

Auxiliary generator	Brush 110 volts D.C.
Traction motor blowers (2)	Motor driven.
Exhausters (2)	Motor driven.
Compressor (1)	Motor driven.
Combined fuel, coolant and lubricating oil priming pump (1)	Motor driven.
Inductor alternator	For wheel slip detection circuits and for supplying main generator separate excitation.
Radiator fans (2)	Hydro-statically driven.
Battery, lead-acid	48 cells, 110 volts.

DRIVER'S CONTROLS IN EACH CAB

1. Master key (removable).
2. Reversing handle with OFF, REV, E.O. and FOR positions.
3. Power controller handle incorporating anti-slip button. The positions marked are: OFF, ON, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and FULL. The positions marked ON and $\frac{1}{4}$ are notched.
4. Vacuum brake valve.
5. Straight air brake valve.
6. Vacuum release valve.
7. Hand brake wheel.
8. Engine start button.
9. Engine stop button.
10. C.W.A. steam ON button (where fitted).
11. C.W.A. steam OFF button (where fitted).
12. Fire alarm test button.
13. Overload reset button.
14. Driver's safety device (DSD) pedal incorporating the " vigilance " device (where fitted).
15. Driver's safety device hold over button, also incorporating the " vigilance " device (where fitted).
16. Horn control, two tone (2) also incorporating a rearward facing horn control.
17. Windscreen wipers (2) and control valves, including a washer.
18. Light switches for cab, engine room, route indicator, tail lights and instrument lights.
19. Cab heater, demister and foot warmer switches.
20. Main fire extinguisher push button—CO_2 equipment.
21. Portable fire extinguishers.
22. A.W.S. switch.
23. A.W.S. reset button.

24. A.W.S. isolating switch.
25. Route indicator operating handles.
26. Boiler emergency shut down switch (where fitted).
27. Inspection lamp socket.

INSTRUMENTS AND GAUGES IN EACH CAB

1. Air pressure gauge (main reservoir).
2. Air brake cylinder pressure gauge (bogie 1 and 2).
3. Vacuum gauge (duplex).
4. Speedometer, scaled 0-100 m.p.h.
5. Traction ammeter.
6. C.W.A. steam pressure gauge (where fitted).
7. Engine stop indicator light (red).
8. Wheel slip indicator light (amber).
9. Fault (general alarm) indicator light (blue).
10. C.W.A. boiler alarm indicator light (white, where fitted).
11. A.W.S. indicator.

CONTROLS AND INSTRUMENTS OUTSIDE THE LOCOMOTIVE

1. Main lighting changeover switch.
2. Fire extinguisher push button (2).
3. Battery charge sockets (1 each side).
4. Shed light sockets (2).
5. Inspection lamp sockets (2).
6. Battery isolating switch OFF handle.
7. Boiler water tank gauges (where fitted).
8. Magnetic type fuel gauges.
9. Boiler fuel shut-off cock (where fitted).
10. Main fuel supply shut-off cocks.
11. Bogie brake cylinder isolating cocks.

INSTRUMENTS AND GAUGES IN THE ENGINE ROOM

1. Charging air pressure gauge.
2. Water pressure gauge.
3. Lubricating oil pressure gauge.
4. Regulating air pressure gauge.
5. Water temperature gauge.
6. Lubricating oil temperature gauge.
7. Control air pressure gauge.
8. Main generator voltmeter.
9. Battery charge-discharge ammeter.

10. Auxiliary generator ammeter.
11. Battery voltmeter.
12. Indicator lights. The lights indicate as follows:-
    (a) Engine lubricating oil pressure.
    (b) Engine cooling water pressure.
    (c) Engine cooling water temperature.
    (d) Traction motor blowers.
    (e) Fuel supply.
    (f) Earth volt.
    (g) Overload.

CONTROLS IN THE ENGINE ROOM AND BOILER COMPARTMENT

1. Engine local START button.
2. Engine local STOP button (must be reset).
3. Exhauster isolating switches (2) EXIS 1 and EXIS 2—OFF-NORMAL-TEST.
4. Water pump set switch: AUTO-OFF-DIRECT.
5. Engine maintenance switch: EMS-NORMAL-MAINTENANCE.
6. Earth isolating switch: EIS-NORMAL RUN-AUXILIARIES ISOLATED-POWER ISOLATED-POWER and AUXILIARY ISOLATED.
7. Traction motor isolating switches. Series parallel locomotives:-
   MIS 1 motors 1 and 2 - IN-OUT
   MIS 2 motors 3 and 4 - IN-OUT
   MIS 3 motors 5 and 6 - IN-OUT
   Traction motor isolating switches. All parallel locomotives:-
   MIS1/2. Motors 1 and 2: 1 IN, 2 IN - 1 IN, 2 OUT - 2 IN, 1 OUT - 1 OUT, 2 OUT.
   MIS3/4. Motors 3 and 4: 3 IN, 4 IN - 3 IN, 4 OUT - 4 IN, 3 OUT - 3 OUT, 4 OUT.
   MIS5/6. Motors 5 and 6: 5 IN, 6 IN - 5 IN, 6 OUT - 6 IN, 5 OUT - 5 OUT, 6 OUT.
8. Manual shutdown lever (push to stop the engine).
9. Battery isolating switch, BIS.
10. Boiler isolating switch in the boiler compartment (where fitted).
11. Brake selector switch.

CIRCUIT BREAKERS AND FUSES

The following circuit breakers and fuses are mounted on the fuse panel over the auxiliary generator:-

Circuit Breakers	Capacity	Type
Control (2)	15 amps	Dorman Smith SP
Lighting (4)	15 amps	Dorman Smith SP

Fuses	Capacity	Type
Pump set motor	125 amps	Brush 125 MO9

Fuses	Capacity	Type
Blower motors	125 amps	Brush 125 MO9
Compressor motor	100 amps	Brush 100 L14
Heaters (2)	60 amps	Brush 60 KO7
Boiler control fuse (where fitted)	60 amps	Brush 60 KO7
Cooker	15 amps	Brush 15 HO7

A battery rectifier fuse is mounted in the control cubicle. This is of 300/400 amps capacity, type EEGS 300/400.

Spare Fuses	Capacity	Type
One	125 amps	Brush 125 MO9
One	100 amps	Brush 100 L14
One	60 amps	Brush 60 KO7
One	30 amps	Brush 30 HO7
One	15 amps	Brush 15 HO7
One	300/400 amps	EEGS 300/400 FP

Colour Identification of Pipe Lines

Line	Colour	Symbol
Air, compressed	White	A.C.
Vacuum	White	A.V.
Air ventilation, exhaust	White	A.E.
Air ventilation, inlet	White	A.I.
Drainage	Black	
Electrical	Light orange	
Fire installations	Signal red	
Oil, Diesel fuel	Light brown	O.D.
Oil, lubricating	Salmon pink	
Oil, boiler fuel	Light brown	O.C.
Steam	Aluminium	
Water, engine cooling	French blue	
Water, C.W.A. feed	Grass green	

GENERAL DESCRIPTION

The Brush Sulzer Class 47 locomotives are powered by a twin bank, twin crankshaft engine with six cylinders in each bank. Two crankshafts are geared together through the medium of a common output shaft pinion, which in turn drives the main generator and auxiliary generator. The Brush Sulzer Class 48 locomotives are powered by a " V " engine with six cylinders in each bank. The main

and auxiliary generator shaft forms an extension of the engine crankshaft. The deployment of the power generated by the two generators can be seen from the chart on page 1.

Cooling System

The coolant is drawn from the radiator system by the coolant pump section of the triple pump and is then forced under pressure to the engine heat exchanger, engine, turbo-charger and inter-coolers. After leaving the engine system, coolant passes through an auxiliary tank and then to a thermostatic valve. The thermostatic valve diverts the coolant from the radiators when it is cold and until it has reached 169°-175°F, after which it passes through the radiator tubes for normal cooling. Two hydrostatically driven fans draw air through the radiator panels. The pressure gauge indicates coolant pressure and a pressure switch stops the engine if the coolant pressure drops to a dangerously low level. The thermometer indicates the coolant temperature when it leaves the engine.

Fuel System

The fuel is drawn from the measuring tank through a strainer by the fuel pump section of the triple pump and is then forced under pressure through fine filters and via the venting vessel to the fuel injection pumps. A release valve allows any excess fuel to be returned to the supplying side of the pump.

Lubricating Oil System

The oil priming section of the triple pump draws oil through a strainer and forces it to the engine main bearings, big end bearings, pistons and engine governor, before the engine is started. When the engine is started an engine driven oil pump draws oil through a strainer and forces a proportion of it through the heat exchanger to the fine filters. From the fine filters oil passes to the engine, engine governor and turbo-charger and finally back to the engine sump. A pressure gauge is provided to show the oil pressure and a pressure switch is provided to stop the engine if the lubricating oil pressure drops to a dangerously low level. A thermometer indicates the lubricating oil temperature when it leaves the heat exchanger.

Brake System

The locomotive is equipped with air brakes, which can be applied directly by a straight air brake valve, or by a vacuum brake valve which will apply the vacuum brakes on the train and give a proportionate air brake application on the locomotive. A vacuum control circuit governor will cut off the power to the traction motors if the brake pipe vacuum falls below 12½ ins. Hg.

Low Tension Electrical System

The auxiliary generator under the control of an automatic voltage regulator provides low tension current at 110 volts for the purpose of charging the battery and supplying power for the auxiliary machines, boiler, cab heaters, cookers and lighting.

Train Heating Boiler

These locomotives are fitted with Spanner Mark IIIB or Stone-Vapor BR 4625 train heating boilers.

The operating instructions for these boilers are given in B.R. 33066/1 " Operating Instructions and Fault Finding Data for Clayton, Stone-Vapor and Spanner Train Heating Boilers ".

FIRE PROTECTION

The locomotive is fitted with two sets of fire fighting equipment:-

1. Portable extinguishers—1 BCF 12 lb. portable extinguisher in each driving cab (these extinguishers are gradually replacing the existing CO_2 and CTC portable extinguishers).
2. Fixed extinguishers—3 CO_2 extinguishers. Two of these are fitted in the engine room and one in the boiler room. If a fire breaks out in the engine room or boiler room, one or more of the fire extinguishers will operate the alarm bell in each cab.
   If the fire bells ring, investigate the cause. Should a fire occur, proceed in accordance with the instructions on page 8 of " Driver's Instructions for the Operation of Diesel Train Locomotives, Diesel Shunting Locomotives and Diesel Multiple Unit Trains with Electric, Hydraulic and Mechanical Transmissions " (B.R. 33003/6 revised April, 1968).
   Before operating the main extinguishers, LOOK FOR THE FIRE TO ENSURE THAT A FALSE ALARM HAS NOT BEEN GIVEN by a fault in the alarm system.

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BRUSH SULZER 2600 H.P. CLASS 47 AND 2650 H.P. CLASS 48 DIESEL ELECTRIC LOCOMOTIVES FITTED WITH VACUUM-AIR BRAKES

PART 2

DRIVING INSTRUCTIONS INCLUDING PREPARATION AND DISPOSAL DUTIES

DRIVER'S DAILY DUTIES

When commencing duty each Driver must have in his possession and retain throughout his turn:-

(a) A master key.

(b) A carriage key.

(c) A door key.

(d) An A.W.S. key on locomotives where removable type keys are used.

The fire bells should be tested from one cab when re-manning.

Cookers must always be switched OFF immediately after use and litter and inflammable materials must not be left on or near cookers where they could catch fire.

NOTE : It must be remembered that a cooker, which is left with its switch in the ON position, will heat up when the Diesel engine is started, and can therefore damage adjacent articles.

PREPARATION DUTIES

1. **At the Locomotive**
Enter the driving cab, deposit personal belongings and equipment. Ensure that the vacuum brake valve is in the RUNNING position and that the straight air brake valve is in the RELEASE position. Check that the hand brake is applied.

2. **External Examination**
Ensure that no depot pipe or electric cables are attached and that the lighting changeover switch is in the BATTERY position. At the driving end of the locomotive:-

(a) Check that the vacuum pipe is secure on the dummy plug.

(b) Check that the main reservoir pipe cock is closed and that the dummy coupler is fitted.

(c) Check that the heater pipe is secured by the chain.
Check that the fuel isolating cocks (2) are open and also that the boiler fuel cock is open when required.
Check the boiler water tank contents gauges (where fitted).

At the non-driving end of the locomotive:-

(a) Check that the vacuum pipe is secure on the dummy plug.

(b) Check that the main reservoir pipe cock is closed and that the dummy coupler is fitted.

(c) Check that the heater pipe is secured by the chain.

(d) Return to the driving cab and take the master key.

3. **Proceed from the Driving Cab through the Engine Room to the Non-driving Cab** en route:-

(a) Check the main fuel contents gauges and the radiator coolant level gauge or sight glass.

(b) Check that the safety pins are removed from the main fire extinguishers and if not, remove them.

(c) Check that the local engine stop button is in the OUT position.

(d) Check that the boiler main stop valve is closed and the main boiler switch is at the OFF position (where fitted).

(e) Close the battery isolating switch.

(f) Check that the traction motor switches are in the NORMAL position.

(g) Check that the circuit breakers are in the ON position and the spare fuses are in position.

(h) Check that the exhauster isolating switches are in the NORMAL position.

(i) Check that the water pump control switch is in the AUTO position.

(j) Check that the PASSENGER/GOODS switch is in the PASSENGER position.

(k) Check that the engine maintenance switch is in the NORMAL position.

(l) Check the engine room door is secure on one side.

4. **In the Non-driving Cab**

(a) Insert the master key and unlock the controller, then move the reversing handle to the EO position.

(b) Check that the vacuum brake valve is in the RUNNING position and the straight air brake valve is in the RELEASE position.

(c) If the A.W.S. change end switch is of the fixed handle type, check that it is in the OFF position.

(d) Check that 12 detonators and 2 red flags are available in the detonator case and that the track circuit shorting clips are in position.

(e) Operate the fire alarm test button.

(f) Set the route indicator to the blank aspect and switch on the tail light.

(g) Check that the doors and windows are closed.

(h) Start the engine. (See page 11 under the heading " Starting the Engine ".)

(i) After starting the engine, apply the power brakes by operating the vacuum brake valve.

(j) Move the vacuum brake handle to the RUNNING position and obtain 21 in. Hg.

(k) Move the reversing handle to the FORWARD position and check the operation of the driver's safety device, by observing that the brakes are applied after a short period and that the vigilance audible device sounds (where fitted).

(l) With the vacuum destroyed, move the reversing handle to the OFF position and then remove the master key leaving the engine running.

(m) Before leaving the non-driving cab ensure that the vacuum brake valve is in the RUNNING position, the straight air brake valve is in the RELEASE position and that the hand brake is released.

5. **Proceed to the Driving Cab through the Engine Room**

(a) Make a careful examination of the engine and generator compartments for obvious defects and check that the other side door is secure.

(b) Close the engine room bulk head doors and enter the driving cab.

(c) Insert the master key and unlock the controller, then move the reversing handle to the EO position. Check that the indicator lights are dim.

(d) Move the A.W.S. switch to the ON position then depress and release the A.W.S. reset button.

(e) Operate the fire alarm test button.

(f) Reset the route indicator as necessary.

(g) Check that 12 detonators and 2 red flags are available in the detonator case and that the track circuit shorting clips are in position.

(h) Check that an air pressure of at least 85 p.s.i. is available.

(i) Check that 21 in. Hg. is registered on the vacuum brake pipe gauge.

(j) Move the straight air brake valve handle towards the FULL SERVICE position checking that the brake cylinder pressure rises to approximately 70 p.s.i.

(k) Return the straight air brake valve handle to the RELEASE position.

(l) Move the vacuum air brake valve handle to a service application position and note that the vacuum is reduced and that the brake cylinder pressure rises. Then move it to the EMERGENCY position, note that the vacuum is destroyed and the brake cylinder pressure rises to approximately 70 p.s.i.

(m) Move the vacuum brake valve handle back to the RUNNING position and note that the vacuum is restored to 21 in. Hg. and the brake cylinder pressure falls to zero.

(n) Move the reversing handle to the FORWARD position and at the same time check the operation of the driver's safety device, by observing that the brakes are applied after a short time and that the vigilance audible device sounds (where fitted).

(o) Test the warning horns, including the rear facing horn.

(p) Apply the straight air brake and release the hand brake.

STARTING THE ENGINE

1. Place the master key into the controller and turn it to the unlocked position.

2. Place the reversing handle into the EO position. This will automatically start the combined pump set and the air compressor will run if the control pressure is below 45 p.s.i. With the reversing handle at EO and the engine stopped, the air compressor supplies air to the control air reservoir only. No additional reading will therefore be shown on the main reservoir air pressure gauge in the cab until after the engine is started. When the reversing handle is in the EO position, the compressor will run until the

pressure rises to 45 p.s.i., after which it will stop. When the compressor stops depress the engine start button firmly and hold it there until the engine fires and the red ENGINE STOPPED light goes dim. A local start button is provided in the engine room and can be used if desired as an alternative. The reversing handle must be put in the EO position in the driving cab before this start button will operate.

BEFORE MOVING THE LOCOMOTIVE

1. Before moving the locomotive ensure that the main reservoir air pressure is at least 85 p.s.i.
2. Make an emergency application of the vacuum brake and ensure that both hand brakes are released.
3. Place the PASSENGER/GOODS switch into the position which is appropriate to the type of train to be worked.

   NOTE : The switch must be in the passenger position when running light locomotive.
4. Move the A.W.S. key to the ON position then depress and release the reset button.
5. Place a foot on the driver's safety device pedal and depress it, then move the reversing handle to the FORWARD or REVERSE position for the desired direction of travel. In locomotives which are fitted with a vigilance type of DSD, the pedal should be depressed to the full position and then released and maintained in the mid-position. At intervals of not more than one minute or when the audible warning sounds, the DSD pedal or either hold over button should be fully depressed and released to the mid-position.

TO MOVE THE LOCOMOTIVE WITH A TRAIN ATTACHED

1. The locomotive must not be allowed to move a train unless:-
   (a) The coupling operations have been correctly performed.
   (b) The PASSENGER/GOODS switch has been placed into the correct position.
   (c) The brakes have been tested in accordance with the regulations in the General Appendix and Supplement thereto.
   (d) The hand brakes and straight air brakes have been released.
   (e) The route indicator has been set and illuminated as necessary.
2. With the reversing handle set to the required direction of travel and the DSD pedal depressed, move the vacuum brake valve handle to the RUNNING position. If a more rapid release of the brake is required, the brake valve handle should be moved to the RELEASE position. Note that the brake pipe vacuum rises to 21 in. Hg. and that the brake cylinder pressure falls to zero.

   NOTE : If the locomotive straight air brake has been used to hold the train stationary on a gradient the brake cylinder pressure will not, of course, fall when the vacuum rises to 21 in. Hg.
3. Release the locomotive straight air brake if this has been applied and note that the brake cylinder pressure falls to zero.

4. Move the power controller to the ON position and then to the ¼ position, applying the anti-slip brake if the rails are greasy. If the train does not move, gradually advance to the ½ power setting. Do not allow the train to remain stationary for more than 15 seconds with the driving ammeter reading in the yellow sector. After the train has moved, increase the power towards the maximum until the required speed is obtained, then adjust the controller position as necessary according to the permanent speed restrictions, etc. A maximum accelerating current of 3,500 amps may be used. Traction current in the order of that quoted above must not be used for more than 2 minutes in any hour. The locomotive may be used continuously with the driving ammeter needle in the green sector of the scale, but operation must be limited to not more than one hour with the driving ammeter needle in the yellow sector.
5. If wheel slip occurs, as indicated by the amber light or speedometer fluctuations, return the power controller to the OFF position, then increase the power again more gradually. If slipping persists move the power controller back to the OFF position, press the anti-slip button and increase the power again. Release the anti-slip button when the slipping has been brought under control. Do not allow the driving ammeter to remain in the yellow sector with the anti-slip button depressed.

BRAKE APPLICATION

1. When it is required to stop the train due to adverse signals etc., firstly move the power controller to the OFF position. If the stop can be contemplated in advance i.e. when it is intended to stop at a station, a pause should be made with the power controller in the ON position before finally moving it to the OFF position.
2. Move the vacuum brake valve handle from the RUNNING position into a SERVICE position. The intensity of the brake application will be indicated by the fall in the brake pipe vacuum and the increase in brake cylinder pressure. When it is desired to bring the train to a stand in the shortest possible distance the vacuum brake valve handle should be moved to the EMERGENCY position which will result in the brake pipe vacuum being reduced to zero.
3. When the brake has been applied as a result of adverse signals being sighted, which then clear before the train comes to a stand, move the automatic air brake valve handle to the RUNNING position. If a more rapid release of the brake is required, the brake valve handle should be depressed in order to speed up the exhausters.
   Re-apply power as necessary when the brake pipe vacuum has risen to 21 in. Hg. and the brake cylinder pressure has been reduced to zero.

DRIVER'S SAFETY DEVICE

If the Driver's safety device pedal is released when the power controller is in a power position a brake application is made after 5-7 seconds delay and the power is cut off. The Diesel engine continues to run at its idling speed. When a D.S.D. application occurs, the following action must be taken to regain control:-

(a) Return the power controller handle to OFF.

(b) Depress the D.S.D. pedal.

(c) Allow time for the brakes to be fully released.

(d) Re-apply power, taking extreme care if a loose coupled train is being worked.

If the Driver's safety device fails it must be cut out by the isolating cock provided for the purpose, and the Driver must, if possible, work the train to the first telephone, signal box or station, report the position and await further instructions.

NOTE : Locomotives of this class are being modified to incorporate the "vigilance" system of Driver's safety device. Vigilance systems have a three position pedal which functions as follows:-

(1) "Released" position i.e. with no pressure applied.

(2) "Balanced" or "Mid" position.

(3) "Reset" position.

A timing device in a vigilance system operates an audible warning after the pedal has been maintained in the "Mid" position for a certain period; usually in the order of one minute. The pedal must then be depressed to the "Reset" position and returned to the "Mid" position. Failure to do this will result in a brake application, 5 to 7 seconds after the sounding of the warning. Pressing either the D.S.D. holdover button to the full "Reset" position or the A.W.S. reset button when the horn is sounding will also reset the vigilance device.

If the pedal or a holdover button is fully depressed for more than 5-7 seconds the brake will be applied.

TO REVERSE THE LOCOMOTIVE

1. Return the power controller to the OFF position.
2. Apply the brakes to hold the locomotive stationary. DO NOT ATTEMPT TO REVERSE WHEN THE LOCOMOTIVE IS MOVING.
3. Move the reversing handle to the opposite direction of travel.
4. Release the brakes, then move the power controller handle as required.

CHANGING ENDS

1. Stop the locomotive.
2. Place the reversing handle in the OFF position.
3. Place the vacuum brake valve handle into the EMERGENCY position and wait until the brake pipe vacuum drops to zero, then move the handle to the RUNNING position.
4. Place the straight air brake valve handle to the RELEASE position.
5. Place the A.W.S. change end switch in the OFF position.
6. Remove the master key.
7. Proceed to the other cab through the engine room.
8. When entering the other cab place the A.W.S. change end switch to the ON position, press and release the A.W.S. reset button and place the master key into position in the controller.
9. Make a holding brake application with the straight air brake valve handle as necessary.

10. Check that the PASSENGER/GOODS switch is in the correct position for the next movement.

TO STOP THE ENGINE

1. Check that the power controller is at the OFF position.
2. Move the reversing handle to the OFF position, then press the engine stop button.

   NOTES :

   (a) The engine must not be stopped until the locomotive has been brought to a stand.

   (b) If the engine stops when on full load for any reason, the reversing handle must be placed in the EO position AFTER the train has been brought to a stand and leave it there for 2 minutes to enable the triple pump set to run and cool the engine evenly. The reversing handle should then be placed into the OFF position.

   (c) In the event of an outbreak of fire the train must be brought to a stand immediately and the reversing handle must be placed into the OFF position as soon as the train comes to a stand. The fire must then be dealt with in the manner described in the booklet entitled Driver's Instructions for the Operation of Diesel Train Locomotives, Diesel Shunting Locomotives and Diesel Multiple Unit Trains with Electric, Hydraulic and Mechanical Transmissions, B.R. 33003/6.

DISPOSAL DUTIES

1. Move the reversing handle to the OFF position then immediately stop the engine and remove the master key.
2. Move the vacuum brake valve handle to the EMERGENCY position, wait until the brake pipe vacuum drops to zero and then move the handle back to the RUNNING position.
3. Apply the hand brake.
4. Place the straight air brake valve handle into the RELEASE position.
5. Close the cab windows and proceed through the engine room to the non-driving cab.
6. In the non-driving cab:-

   (a) Apply the hand brake.

   (b) Check that the windows and doors are closed.

   (c) Switch off the route indicator lights, tail lights and cab lights.
7. Enter the engine room and open the battery isolating switch, then proceed to the driving cab.
8. In the driving cab switch off the route indicator, instrument lights and cab lights. Collect personal gear and leave the cab closing all doors.
9. Place the main lighting switch to the SHED position.
10. Hand the control and door keys etc., to the responsible person at the depot.

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BRUSH SULZER 2600 H.P. CLASS 47 AND 2650 H.P. CLASS 48 DIESEL ELECTRIC LOCOMOTIVES FITTED WITH VACUUM-AIR BRAKES

PART 3

FAULT FINDING DATA AND CHARTS

FAULT FINDING INSTRUCTIONS

General

In the following text the word "engine" refers to the Diesel Power Unit within the locomotive. The word "engine" is not to be used when referring to the locomotive as a whole. This is very important when reporting defects.

Warnings

Warnings of various defects are given by three coloured lights on the driving desk. These normally glow dimly. When a fault occurs they become bright although in rare cases or when extensive defects occur they may all become extinguished. If one indicator light becomes extinguished the corresponding indicator in the rear cab should be checked and if this glows dimly the locomotive may proceed.

The indications are as follows:-

(a) Red light bright—Diesel Engine stopped.

(b) Amber light bright—Wheel slip. If amber light indications are given over 45 m.p.h. a fault in a traction motor or its associated circuitry may be the cause.

(c) Blue light bright—This indicates a fault or faults which are individually indicated on the engine room fault panel as follows:-

(i) OVERLOAD LIGHT—This will glow brightly if the overload relays have operated as a result of excessive traction current being used.

(ii) BLOWERS LIGHT—This light will glow brightly if a traction motor blower fails.

(iii) EARTH FAULT—This light will glow brightly if traction or auxiliary current passes through the frame of the locomotive as a result of faulty electrical insulation.

(iv) FUEL SUPPLY—This light will glow brightly when the fuel level in the main tank falls below 38 gallons.

(v) WATER PRESSURE—This light will glow brightly if the coolant pressure drops below 4 p.s.i.

(vi) WATER TEMPERATURE—This will glow brightly if the coolant temperature rises above 200°F.

(vii) OIL PRESSURE—This light will glow brightly if the oil pressure in the diesel engine falls below 12 p.s.i.

In addition to the indicators on the driving desk a white indicator light is provided on boiler fitted locomotives. This is to be extinguished when the boiler is not working, but glows dimly when it is working normally.

Effect of rupturing of the fuses in the control and auxiliary systems of the locomotive when in service

PUMP SET MOTOR FUSE, 125 amps. The triple pump motor will stop. The engine will shut down. A red warning light will be given on the driving desk.

BLOWER MOTORS FUSE, 100 amps. The traction motor blowers will stop. A blue warning light will be given on the driving desk.

COMPRESSOR MOTOR FUSE, 100 amps. The compressor will stop. Air pressure will be lost. Traction power will be lost. A blue fault warning will be given on the driving desk when the controller is opened.

BOILER CONTROL FUSE, 60 amps. The train heating boiler will shut down.

BATTERY RECTIFIER FUSE, 300/400 amps. The batteries will be discharged.

Fuse ratings may be altered from the above values if experience proves this to be necessary. The correct value of the replacement fuse should always be checked.

Effect of circuit breakers tripping on a locomotive in service

CCB1 (positive) and CCB2 (negative). The diesel engine will stop and all warning lights will be extinguished.

CHANGING FUSES

In the event of a fuse failure, one of the spares may be used, but care must be taken that it is one of the same capacity as the defective one. The fuses can be identified by their marking. Test all suspected fuses and replacements on the fuse tester.

The following procedure should be used for changing fuses:-

(1) Stop the engine, then place the battery isolating switch in the OFF position.

(2) Remove the suspected fuse.

(3) Hold the fuse by the centre portion and place it across the tester contacts which are alive. If the fuse is in good order the lamp will light.

(4) Re-new the fuse if defective.

(5) Place the battery isolating switch to the ON position after replacing the fuse.

IMPORTANT : The battery switch MUST always be placed in the OFF position before removing or replacing a fuse.

DRIVING COMPARTMENT INSTRUMENT READINGS AFTER THE ENGINE HAS BEEN RUNNING AT LEAST 5 MINUTES

Instrument	Readings		Action to be taken if incorrect readings are given
	Loco Standing	Loco Moving	
Main Reservoir Air Pressure Gauge	85-100 p.s.i.	85-100 p.s.i.	Report any variations below the minimum or above the maximum. If pressure is lost See Page 27
Brake Cylinder Pressure Gauge	0-70 p.s.i.	0 p.s.i.	Any variations from the maximum pressure of 67-73 p.s.i. must be reported in the Repair Book.
Vacuum Gauge	0-21 in. Hg Brake Pipe 21 in. Hg Vacuum Chamber	21 in. Hg Brake Pipe 21 in. Hg Chamber	See Page 27
Speedometer	0	0-95 m.p.h.	The maximum speed indicated in the driving compartment must not be exceeded.
Driving ammeter	0	0-3750 amps Series parallel	The maximum current indicated must not be used for more than one minute. Rapid fluctuations in the driving ammeter reading must be reported giving details of the controller position, locomotive speed, mile post position and any fault or wheel slip indications.
	0	0-7500 amps. All parallel	

ENGINE ROOM INSTRUMENT READINGS AFTER THE ENGINE HAS BEEN RUNNING AT LEAST 5 MINUTES

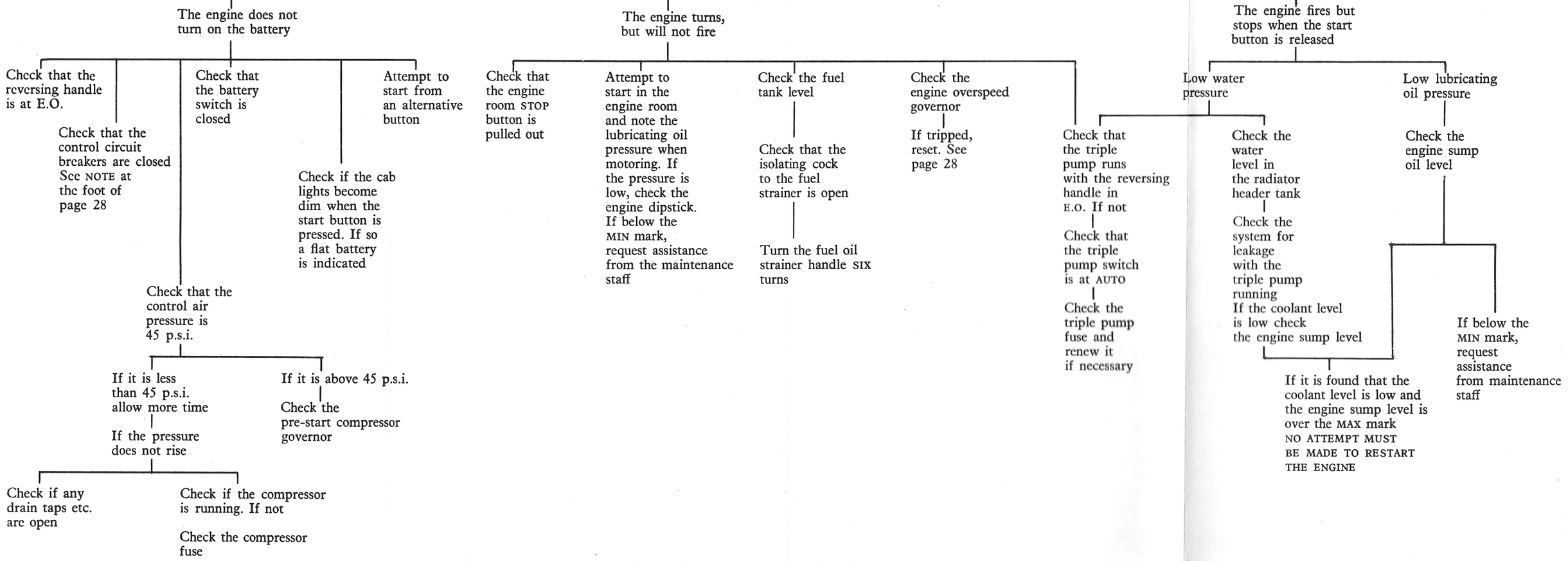
Instrument	Readings		Action to be taken if incorrect readings are given
	Loco Standing	Loco Moving	
Water Temperature Gauge	Variable	160°-180°F	A blue fault light warning is given if the temperature exceeds 200°F. The locomotive must be worked at reduced power to a convenient stopping place where the action described in the fault finding chart must be carried out.
Lubricating Oil Temperature Gauge	Similar to the coolant	Similar to the coolant	The locomotive must be failed if temperature exceeds 200°F. The engine must be shutdown immediately if an excessive " knock " is heard.
Battery Voltmeter	110 Volts	110 Volts	Report any variation.
Main generator Voltmeter	0	0-900 Volts Series-parallel 0-450 Volts All parallel	The maximum readings are only obtainable when the locomotive is travelling at maximum speed with the controller fully opened. Report any rapid fluctuations in the readings.
Charging Air Pressure Gauge	0	0-15 p.s.i.	If 12 p.s.i. cannot be obtained when working on full power, the fact must be reported in the Repair Book. If the locomotive is under powered for any reason, the maximum charging air pressure cannot be obtained.
Battery Charging Ammeter	Variable charge according to the battery condition	Variable charge according to the battery condition	This instrument will give a higher reading immediately after the engine has been started. If a discharge is indicated a locomotive must be failed at the first opportunity.
Control Air Pressure Gauge	70 p.s.i.	70 p.s.i.	Report any variations in the repair book. Continue working normally unless the pressure drops to 55 p.s.i. which will cause loss of power.
Auxiliary Generator Ammeter	Variable	Variable	Report any rapid fluctuations.
Regulating Air Pressure Gauge	0	0-50 p.s.i.	Proceed but report the defect if the maximum varies by more than 5 p.s.i. at the full power position of the controller.

Instrument	Readings		Action to be taken if incorrect readings are given
	Loco Standing	Loco Moving	
Water Pressure Gauge	15-20 p.s.i.	15-20 p.s.i.	If the pressure remains steady above 20 p.s.i. the locomotive should work forward to its destination and the defect reported in the Repair Book. If the pressure fluctuates rapidly above 20 p.s.i. the locomotive should be failed at the earliest opportunity, because this may indicate a defect in the cylinder liner.
Lubricating Oil Pressure Gauge	20-30 p.s.i.	20-50 p.s.i.	If the oil pressure falls to 12 p.s.i. the diesel engine will shut down. All cases of oil pressure above or below the specified readings opposite must be reported in the Repair Book.

NOTES FOR THE GUIDANCE OF DRIVERS WHEN A FAULT OCCURS

1. If a locomotive shows only a slight reduction of power no immediate action is necessary. A check on the equipment should be made at the next stopping point. If no obvious defects can be seen the journey may be completed.
2. If a severe reduction of power occurs an investigation should be made within five minutes, at the most convenient stopping place. An immediate stop may be necessary if the shortage of power is accompanied by excessive vibration, noise or smoke from any part of the locomotive. If a period of coasting will allow the train to proceed to a booked stopping point, there is no need to bring it to a stand within five minutes, provided that no serious defects are evident.
3. A shortage of power will probably be accompanied by a warning light becoming bright or an abnormal instrument reading. All indications should be noted before the train is brought to a stand. GREAT CARE MUST BE TAKEN TO ENSURE THAT NO SIGNAL ASPECTS OR LINESIDE WARNING BOARDS ETC. ARE MISSED WHENEVER INDICATORS OR INSTRUMENTS ARE BEING CHECKED.
4. If a complete loss of power occurs, but the exhausters are still running, an attempt should be made to coast and bring the train to a stand under the protection of the next fixed signal.
5. In the event of a Diesel engine shutting down in service an application of the brakes will occur and the train should therefore be stopped, if possible, at the next fixed signal.
   When a train has been brought to a stand as a result of a locomotive failure and the necessary Rules have been carried out, refer to the chart with a heading applicable to the indication or defect. This will show the various possible causes of the trouble and indicate the action to be taken.
   In some instances the possibilities may be numerous and the simpler defects should be checked before the more difficult ones. When a cause for a defect can be definitely established and it is known that it can be corrected, inform the nearest signalman, station official or the Traffic Control stating how long it will be before the trouble can be overcome. Return to the locomotive and take the necessary action. When the defect has had attention, start the engine and make a test to ensure that traction power can be obtained and that the auxiliaries function normally. The train may then be worked forward.
   If any doubt exists as to the possibility of overcoming the fault, a fresh locomotive must be requested immediately. If the defective locomotive can only work forward on reduced power arrangements must be made for a fresh locomotive to be provided at some point on the journey.
   At the end of the journey the defect must be reported, and the full facts must be entered in the Repair Book. This will greatly assist the maintenance staff at the depot to where the locomotive is taken in identifying the cause of the defect.
   The following chart indicates the readings normally given by all the instruments and indicates the action to be taken if incorrect readings are given when the engine is running.

THE ENGINE WILL NOT START WHEN THE START BUTTON IS PRESSED


The engine does not turn on the battery
Check that the reversing handle is at E.O.
Check that the control circuit breakers are closed See NOTE at the foot of page 28
Check that the battery switch is closed
Attempt to start from an alternative button
Check if the cab lights become dim when the start button is pressed. If so a flat battery is indicated
Check that the control air pressure is 45 p.s.i.
If it is less than 45 p.s.i. allow more time
If the pressure does not rise
Check if any drain taps etc. are open
Check if the compressor is running. If not
Check the compressor fuse
If it is above 45 p.s.i.
Check the pre-start compressor governor
The engine turns, but will not fire
Check that the engine room STOP button is pulled out
Attempt to start in the engine room and note the lubricating oil pressure when motoring. If the pressure is low, check the engine dipstick. If below the MIN mark, request assistance from the maintenance staff
Check the fuel tank level
Check that the isolating cock to the fuel strainer is open
Turn the fuel oil strainer handle SIX turns
Check the engine overspeed governor
If tripped, reset. See page 28
Check that the triple pump runs with the reversing handle in E.O. If not
Check that the triple pump switch is at AUTO
Check the triple pump fuse and renew it if necessary
The engine fires but stops when the start button is released
Low water pressure
Check the water level in the radiator header tank
Check the system for leakage with the triple pump running If the coolant level is low check the engine sump level
If it is found that the coolant level is low and the engine sump level is over the MAX mark NO ATTEMPT MUST BE MADE TO RESTART THE ENGINE
Low lubricating oil pressure
Check the engine sump oil level
If below the MIN mark, request assistance from maintenance staff

If the engine cannot be started after the above checks have been carried out assistance must be obtained from maintenance staff

ALL DEFECTS MUST BE REPORTED

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THE LOCOMOTIVE WILL NOT MAINTAIN RUNNING TIMES

PROBABLE CAUSE

A traction motor or pair of traction motors isolated

Request authority before restoring any motors into circuit. Check the entries in the Repair Book

Partial blockage of the fuel strainer

Turn the fuel strainer handle six times

A fuel injection pump isolated

Stop the engine. Check the fuel pumps. If any are found isolated check the Repair Book for the reason. If no reason can be established re-engage the pump(s). Note if there is any fuel leakage or unusual noise. If so re-isolate the pump(s). Proceed normally.

The engine air filters are badly choked with dirt

Check the condition of the supercharger air filters. If badly choked with dirt fail the locomotive at the first convenient place

NOTE: The engine governor indicator will indicate 8.6 when the locomotive is being worked with the controller fully opened between 15 and 80 m.p.h. If this indicator gives lower readings with the controller fully opened, a fault exists in the locomotive

These faults will result in a reduction of pressure charging although the supercharger is in good order. The main ammeter reading will be lower than normal. The engine governor indicator will read less than 8.6 with the controller in the full power position

Either or both locomotives handbrakes ON

Check the handbrakes

A brakevan or wagon handbrake ON

Check the train brakes

A straight air brake valve in a partially applied position

Check the gauge Check both brake valves

If the loco brakes are not fully released and all brake valves are in their running positions, operate the vacuum chamber release valve until the brake cylinder pressures fall to zero

The vacuum brake not fully released

Check the train for a passenger communication

Check the locomotive and train for defects

Pull the brake release cords

Full pressure charging will be obtained in these circumstances

ALL DEFECTS MUST BE REPORTED

THE AMBER WHEEL SLIP LIGHT BECOMES BRIGHT

PROBABLE CAUSE

One or more pairs of wheels slipping

If slipping persists, ease the controller to a lower position then notch up again

If slipping still persists. Move the controller back to the OFF position. Press the anti-slip button. Advance the controller to the required position. Release the anti-slip button.

At speeds above 45 m.p.h.

Check if either handbrake is on

If occasional indications are given, proceed but report the defect

If frequent or continuous indications are given

Reduce the power immediately and stop at the first convenient point

Isolate a pair of traction motors and proceed. If the indications are given again, reduce the power immediately and stop at the first convenient point. De-isolate the motors and isolate a further pair. If the indications are given again, repeat the above. Proceed, but do not exceed 2300 amps or 1400 amps continuously, series parallel locos or 4600 amps or 2800 amps continuously, all parallel locos

ALL DEFECTS MUST BE REPORTED

THE BLUE FAULT LIGHT BECOMES BRIGHT

Power is not lost when running

Stop at the first convenient place

Inspect the fault panel in the engine room

PROBABLE INDICATIONS

WATER TEMPERATURE light bright

Check the coolant temperature

- If 190°F to 200°F proceed at low power until the temperature is normal
- If over 200°F, wait until the temperature drops to 175°F before moving

Check that the radiator fans are running

- If they are not fail the locomotive
- If they are turn the engine coolant by-pass lever to DIRECT

FUEL SUPPLY light bright

Shut the boiler down if in use

Run for not more than 20 minutes

BLOWERS light bright

Check a traction motor blower

If stopped check the fuse. Renew if ruptured

If the fuse has not ruptured continue in service for not more than ONE HOUR and limit the traction current to:-
2100 amps for series-parallel locomotives.
4200 amps for all parallel locomotives

Power cannot be obtained when opening the power controller,

PROBABLE CAUSE

The engine maintenance switch is OPEN

Check with the maintenance staff before closing the switch

The A.W.S. switch is open in the driving cab and/or closed in the non-driving cab

Place the A.W.S. switches in their correct positions

The vacuum has not risen to 15" Hg.

Allow more time for the vacuum to rise. If it does not

Check that the exhauster switches are in the NORMAL position. If the vacuum remains at zero

Check the rear cab brake valve

Check for defects in the D.S.D.

Check for defects in the train, Guard's application etc.

The main reservoir pressure has not risen to 75 p.s.i.

Allow more time for the pressure to rise. If it does not

Check if the compressor is stopped. If it is

Move the trigger on the compressor governor manually. If the compressor starts, isolate the governor

If the compressor does not run check the fuse and change it if necessary

The main reservoir pressure has fallen to 60 p.s.i. or below

Check for leakage

If power cannot be obtained after carrying out the above checks, assistance must be obtained from the maintenance staff

ALL DEFECTS MUST BE REPORTED

Power is lost when running,

PROBABLE INDICATIONS AND CAUSES

The vacuum has dropped to 12½" Hg or below

Check for:-

(a) A passenger communication

(b) An application by the guard

(c) Leakage and defects in the train

(d) Defective A.W.S.

(e) Defective D.S.D.

EARTH FAULT light bright

Turn the EARTH ISOLATING SWITCH to POWER ISOLATED

Proceed normally and report the fault in the Repair Book

OVERLOAD light bright

Close the power controller

Press the OVERLOAD RESET BUTTON
This will cancel the cab fault indication

If the amber WHEEL SLIP light becomes bright or persistent overload indications occur, a traction motor may be defective. Proceed as shown on page 26

OIL PRESSURE light bright

This will become bright when the Diesel engine stops due to low lubricating oil pressure.
A red ENGINE STOPPED indication will also be given in the cab. See page 28

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THE RED ENGINE STOPPED LIGHT BECOMES BRIGHT

Stop at the most convenient place before the vacuum is destroyed or air pressure is lost. Carry out any necessary protection rules.

PROBABLE CAUSE

The engine overspeed governor tripped

If tripped reset and note if the fuel pump control shafts move freely

If the overspeed device trips again check each pump in turn for a seized rack

If a seized rack is found isolate the pump and restart the engine

If overspeeding occurs again, limit the controller position and proceed. Fail the locomotive at the most convenient place

Do not reset the overspeed governor more than three times

Low coolant pressure

Check the WATER PRESSURE light. If bright: -

Check if the triple pump is running. If not

Check the fuse and renew it if necessary

Low lubricating oil pressure

Check the OIL PRESSURE light. If bright: -

Check the engine sump dipstick. This should be above the MIN mark with the triple pump running. If above the MIN level but below the MAX, attempt to restart the engine.

If the engine will start note the oil pressure

If above 20 p.s.i. proceed and fail at the first convenient place unless a different fault caused the engine to stop and has been rectified

If below 20 p.s.i. fail the locomotive

Shortage of fuel

Check the LOW FUEL light

If bright

Shut the boiler down

Proceed for not more than 20 minutes running on full power

If not bright

Turn the fuel strainer handle

Restart the engine

Proceed. If the locomotive appears to be seriously underpowered fail at the first convenient place

NOTE: If the Diesel engine stops and ALL warning lights become EXTINGUISHED the control circuit breaker should be checked and reset if tripped.

ALL DEFECTS MUST BE REPORTED